Forest Health Protection

Pacific Southwest Region

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Pauma Forest Health Surveys

Background

The Pauma Mission Reserve was surveyed on September 9, 2009 for evidence of insect and disease issues. Forest Health Protection entomologist, Tom Coleman and pathologist, Paul Zambino accompanied Jeremy Zagarella and members of the Pauma fire department across the reserve. A second survey was conducted by Coleman and Zagarella on February 3, 2010 around the community of Pauma for additional insect and disease issues impacting the oak component.

Following the 2007 Poomacha wildfire, low levels of pine mortality are occurring across the Pauma Mission Preserve. Coulter pine, *Pinus coulteri*, is the most prominent pine species in the reserve, and has been dying over the past several years. Large diameter Coulter pine, are primarily being killed by bark beetles. Western pine beetle, *Dendroctonus brevicomis*, and pine engraver bark beetles, *Ips* spp., were the most prominent bark beetle species found to be active on the reserve. Total pine mortality was limited (~10 trees), but active populations were found in multiple areas and may continue to cause tree mortality (Fig. 1).

Entomology surveys

Tree mortality from western pine beetle and pine engraver bark beetles is most likely linked to previous wildfire injury and dense tree stocking. The 2007 Poomacha wildfire impacted a majority of the reserve. Tree mortality was extensive and additional mortality is still occurring. Wildfire injury most likely increased tree stress and subsequently the susceptibility of pines to bark beetle attack. Those larger diameter pines that escaped fire mortality are now succumbing at low levels to bark beetle injury and mortality. Three areas were found with active western pine beetle populations. Evidence of western pine beetle on Coulter pine was determined by the presence of red pitch tubes, winding egg galleries under the bark, and adult beetles (Fig. 2). Tree mortality has been limited since the wildfire, but populations could build and cause additional tree mortality. Pine engraver bark beetles are commonly associated with stress events and large populations typically collapse after a few years with limited tree mortality occurring. This bark beetle species is not a serious concern at this time for the reserve.

Figure 1. Tree mortality from western pine beetle on the Pauma Mission Reserve.

Western pine beetle is an aggressive bark beetle species capable of causing extensive tree mortality. This bark beetle prefers mature, large diameter ponderosa pine, *P. ponderosa*, and Coulter pine. Several management options are available to prevent tree mortality from this species. Long-term prevention of bark beetles can be accomplished by reducing mature pine

stand density to 80 trees/ac. This management option will reduce competition for water and nutrients between pines and thus increase individual tree health. Reducing the cover of shrubs will further reduce competition with pines. Healthy pines are capable of fending off bark beetle attacks by "pitching-out" new attacks with copious amounts of resin flow. These defense techniques are seriously reduced when a pine is stressed from injury or over competition. Additional stress factors were also found across the reserve, which can further increase tree susceptibility to bark beetles. These agents are discussed in the Pathology surveys below.

Short-term options for preventing pine mortality can be achieved by spraying insecticides. High-value trees can be sprayed topically with Carbaryl along the main bole. This treatment is a short term solution for preventing tree mortality, but can provide protection for up two years. Insecticide sprays should only be used if active populations are still in the area.

The second entomology survey focused on oak health issues in the community of Pauma. A new invasive wood borer, the goldspotted oak borer (*Agrilus coxalis*), is causing extensive tree mortality further south in San Diego County (Fig. 3). The new woodborer aggressively kills coast live oak, California black oak, and canyon live oak. Coast live oak is the prominent tree species in the community, whereas California black oak and canyon live oak are most abundant in the Mission Reserve. Goldspotted oak borer was not found at any site on the Pauma reservation. Species, tree diameter, and a health rating were assessed for all coast live oaks in the community. Flight-intercept prism traps were also hung at several locations to monitor this new invasive beetle. These areas will be revisited in the future to continue surveying for the goldspotted oak borer.

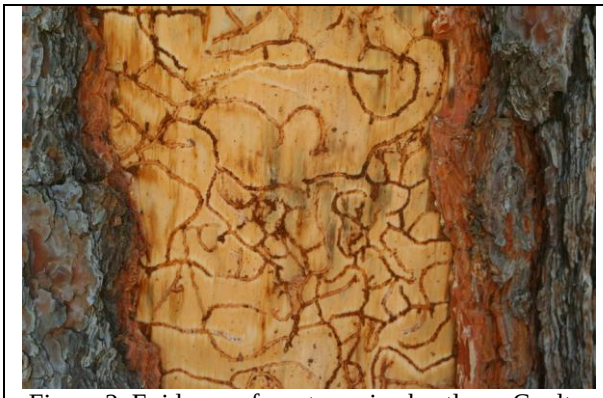

Figure 2. Evidence of western pine beetle on Coulter pine.

Figure 3. Goldspotted oak borer larval galleries in coast live oak, but not found in Pauma surveys.

Pathology surveys

Two significant diseases were found that require management for stand health: western dwarf mistletoe (*Arceuthobium campylopodum*) and the pine-infecting form of Heterobasidion root disease (also called annosus root disease) caused by the fungus *Heterobasidion irregulare*.

Western dwarf mistletoe on Coulter pine is currently causing the most damage in the Pauma Preserve, causing branch and bole infections, witches' brooms, and increased susceptibility to damage from stress, insects, and fire. Overstory and regenerating trees were affected to different degrees at different sites. Management efforts to control this disease were seen at several locations, and control should continue to be a priority to prolong the life of individual trees, prevent spread to nearby susceptible trees, decrease susceptibility to insect attack, and allow for greater health in stands after regeneration.

Figure 4. Bole infections of Western dwarf mistletoe in fire-scorched Coulter Pine.

Figure 5. Conk and decay of Heterobasidion root disease in piece of Coulter pine stump.

For control measures to be effective, individual trees and stands will need to be examined to determine which overstory and replacement trees should be pruned or removed, and areas where regeneration should be promoted prior to tree removal. Use of the Hawksworth 0-6 rating system will identify trees with little chance of survival, and those that will benefit from pruning. Individual stand exams can identify some heavily infected and declining trees that should be culled and others that could be retained on a short-term basis, until there is evidence of regeneration cohort in the understory; such regeneration has already started in some areas within and outside the Poomacha fire boundaries. Regeneration outside the fire could be promoted by basal area and understory reduction for reducing bark beetle susceptibility, or by prescribed fire.

Without ongoing control, stands could undergo stand structure degradation. Significant delay in implementing dwarf mistletoe control in stands with intermediate ranking has long-term consequences in gradual loss of overstory and severe infection of understory, only buffered by the mix of other tree species not susceptible to mistletoes. Without control, expectations for overstory conifers with dwarf mistletoe are that individual trees progress one mistletoe severity category per decade (Hawksworth ratings 1-6), with mortality in the decade following the highest rating, 6, often associated with bark beetle infestation, and understory trees will have high proportion of bole and top canopy infections.

Branch pruning is highly effective in overstory trees at dwarf mistletoe ratings up to 4, and can restore vigor, renew top growth and diameter increments, and lessen susceptibility of intermediate-rated trees to loss from other stresses, such as insects and other diseases. By the time trees reach rating 5 or 6, pruning has no benefit to the individual tree but can still reduce mistletoe seed loads while allowing pine seed to contribute to regeneration prior to removal. Individual heavily infected trees can have value as retained trees where the objective is to maintain witches brooms as nesting sites for birds. Understory around heavily infected leave trees should be converted to tree species not susceptible to western dwarf mistletoe. Oaks, big cone Douglas-fir, incense cedar, and sugar pine are all immune to this species of dwarf mistletoe, but ponderosa and Jeffrey pines are susceptible.

A tree's severity of dwarf mistletoe infection results depends partly on genetic resistance, and resistance varies within stands. Because of this, it may be possible to improve the resistance

of these stands during thinning. Intermediate diameter-class trees that are uninfected or have very low infection despite being close to heavily infected overstory should be retained, even if this means removing larger, more heavily infected trees. Understory trees are susceptible to infection if within two treelengths of overstory trees.

A method of controlling bole infections seen at one site on the Pauma is not recommended for use in future control: the use of chainsaw "surgery" on boles followed by treatment with tree paint. Although this removes some obvious shoots, the within-tree system of mistletoe extends well beyond the visible shoots, so shoots will re-grow. A better approach would be to spray Ethephon on mistletoe shoots throughout the tree before mistletoe seeds are mature. This releases a natural plant hormone that causes the mistletoe shoots to drop off. A single treatment can eliminate or reduce new seed production from bole infections for 2-5 years. This could allow regeneration before reentry to remove infected overstory.

Exposure to fire or prescribed fire can cause mistletoe shoots to drop, even well above the scorch height, which temporarily reduces seed production; it also torches and kills heavily affected trees that have abundant witches brooms and accumulations of fine fuels at the base. However, abundant shoots were already evident on boles of surviving trees scorched by the Poomacha fire two years earlier. This indicates that use of prescribed fire to cause mistletoe shoots to drop would cause at most a temporary reduction in shoots. Such fire effects are not reliable or predictable.

Heterobasidion root disease was found in several stumps as conks and as characteristic rot that separates along growth rings and becomes "stringy", but disease centers were fairly inactive at the time of the exam. Symptoms to watch for around such stumps include crown thinning, small clusters of trees attacked by insects, and tree lodging. Once established in stumps, this disease can pass from tree to tree by root contact among hosts, including ponderosa pine, Jeffrey pine, sugar pine, Coulter pine, incense-cedar, western juniper, and pinyon pine. Removing one row of trees beyond those with symptoms of infection can cause infection centers to die out.

Precautions should be in place to protect conifer stumps created during treatments, as their colonization by spores would allow Heterobasidion root disease to become much more widespread, and affect many generations of trees. Even stumps of conifer species that are not normally attacked by the pine-infecting form of the disease need to be treated. The standard protocol of immediatly treating stumps 3 inches or greater in diameter with borate fungicide will prevent stump colonization. Sporax® is a dry powder; Cellutreat® is a liquid form that has only recently been registered for forest use in California. The only conifer stumps not requiring treatment are those from beetle-killed trees that have completely lost their brown needles, and stumps from trees that lost all needles in a fire, and are being cut at least one year after the fire. However, stumps of black trees killed and cut within a year of a fire can still be colonized and must be treated.

Conclusion

Fire injury and mortality on the reserve have killed a majority of the pines and increased susceptibility to bark beetles. To maintain the pine component in this area, additional pines may need to be replanted or site prep/understory thinning may be required to promote regeneration. If western pine beetle populations persist and continue to threaten high-value sites (e.g. cultural sites) on the reserve, an insecticide application may be required to stop tree mortality. Treatment

for dwarf mistletoe will benefit stand health and reduce beetle susceptibility; timely overstory control will be necessary to ensure that regeneration will be healthy. Conifer stumps from bark beetle and mistletoe operations must immediately be treated with a borate fungicide to prevent Heterobasidion root disease. Once the goldspotted oak borer is detected in or near Pauma, additional management can be suggested to prevent tree mortality from this species.

If there are additional questions or forest health concerns, please contact Forest Health Protection, Southern California Shared Service Area.

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